PATENT ABSTRACTS OF JAPAN

(11) Publication number : 06-316442
(43) Date of publication of application : 15.11.1994

(51) Int.Cl. C03C 17/34
C03C 17/245

(21) Application number : 06-039969
(22) Date of filing : 10.03.1994
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(30) Priority
Priority number : 05 78903 Priority date : 12.03.1993 Priority country : JP

(54) MULTILAYER ANTIREFLECTION FILM HAVING CONDUCTIVITY

(57) Abstract:
PURPOSE: To provide a conductive multilayer antireflection film at a low cost with a high productivity by successively laminating a first-layer film of λ0/4 and a second layer as a specified laminated film of λ0/4 from the glass substrate side and making the outermost film conductive.
CONSTITUTION: A first-layer film of λ0/4 and a second-layer film of λ0/4 are successively formed from the glass substrate side to obtain a multilayer antireflection film as follows. Namely, the second-layer film is formed with laminated high-refractive-index film and low-refractive-index film, and the outermost film is made conductive. The first-layer film may be formed with either a conductive material or a nonconductive material, however an almost insulating material is prefreably used. The multilayer antireflection film having conductivity and high transmittance is useful for the electric display element, photoelectric conversion element or touch panel needing improved visibility.

LEGAL STATUS

[Date of request for examination]	21.02.2001
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	

[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] It is the multilayer antireflection film which the 2nd aforementioned layer membrane is a cascade screen which consists of the combination of a high refractive-index layer and a low refractive-index layer in the multilayer antireflection film which carried out the laminating of the 1st layer membrane of lambdao / 4, and the 2nd layer membrane of lambda0 / 4 one by one from the glass-substrate side, and has the conductivity characterized by an outside layer being a layer which has conductivity most from a glass-substrate side.
[Claim 2] The multilayer antireflection film of the claim 1 which comes to manufacture the 1st layer membrane and the 2nd layer membrane using ordinary-pressure CVD.
[Claim 3] The multilayer antireflection film of the claims 1 or 2 to which the 1st layer membrane is the tin oxide and the 2nd layer membrane carries out the laminating of silicon oxide and the conductive tin oxide one by one from the 1st layer membrane side.
[Claim 4] the [the tin oxide of the 1st layer membrane, and/or] -- the multilayer antireflection film of the claim 3 which is what is formed considering at least one sort as which the tin oxide in 2 layer membranes is chosen out of water, a methanol, and fluoric acid, and tin chloride as a raw material
[Claim 5] The multilayer antireflection film of the claims 3 or 4 whose thicknesss of 5-140nm and the tin oxide the thickness of the tin oxide of the 1st layer membrane is 40-100nm, and the thickness of the silicon oxide of the 2nd layer membrane is 5-100nm.
[Claim 6] The multilayer antireflection film of the claim 5 whose thickness of 30-80nm and the tin oxide the thickness of the tin oxide of the 1st layer membrane is 50-80nm, and the thickness of the silicon oxide of the 2nd layer membrane is 20-60nm.
[Claim 7] The multilayer antireflection film of any 1 term of the claims 1-6 whose sheet resistance of a multilayer antireflection film is 300-5000ohm/**.
[Claim 8] The multilayer antireflection film of any 1 term of the claims 3-7 whose sheet resistance of the tin-oxide layer of the 1st layer membrane is more than 1000ohms / **.
[Claim 9] The multilayer antireflection film of any 1 term of the claims 3-8 whose sheet resistance of the tin-oxide layer which constitutes the 2nd layer membrane is 300-5000ohm/**.
[Claim 10] The multilayer antireflection film of any 1 term of the claims 1-9 for which the window layer member of an electro-optics element or an optoelectric transducer is used in part at least.
[Claim 11] The touch panel characterized by using the multilayer antireflection film of any 1 term of claims 1-9 for the aforementioned glass with an electric conduction layer in the touch panel which consists of a part or all of the plastics film with an electric conduction layer, a spacer, and the glass with an electric conduction layer.

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* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the multilayer antireflection film which has the conductivity used as window layer member of electrical parts, such as a touch panel and a solar battery.
[0002]
[Description of the Prior Art] When using transparent optical members, such as glass, for an optoelectric transducer or touch panels, such as electro-optics elements, such as a liquid-crystal-display element and a plasma display panel, and a solar battery, etc. as a window layer member directly or indirectly conventionally, it was important to raise visibility and a conversion efficiency. For this reason, preparing an antireflection film in a front face and raising the amount of transmitted lights by the side of a member tooth back as the technique of reducing the reflection loss in these optical member front face, and raising permeability, is known.
[0003] the multilayer more than the monolayer for which the layer configuration of an antireflection film used the optical interference from the former, or two-layer **** -- becoming -- TiO2, ZrO2, SiO2, and aluminum2 O3 etc. -- there are few examples about the multilayer antireflection film which the electric-insulation material is used and gave conductivity
[0004] ITO, the tin oxide, and the zinc oxide are known as a thin film material which has conductivity with the transparence and high refractive index for giving conductivity on the other hand. ITO and a zinc oxide are produced by the technique which mainly used vacuums, such as a vacuum deposition method or a spatter. On the other hand, about the tin oxide, since the controllability of a high vacuum method of optical/electrical property is bad, using the pyrolysis reaction under atmospheric pressure, such as CVD which makes the spray method or raw material which generally used powder or the liquid raw material evaporate, is known.
[0005] That is, as mentioned above, by the layer material, the optimum producing [a film] methods differ, having some kinds of film production equipments by the layer material influences an installation cost and a productivity greatly, and it serves as a serious failure in respect of a cost.
[0006]
[Problem(s) to be Solved by the Invention] this invention aims at offer of the high object for the electro-optics elements of the productivity efficiently manufactured by the low cost, the object for optoelectric transducers, or the new transparent conductivity multilayer antireflection film for touch panels.
[0007]
[Means for Solving the Problem] In the multilayer antireflection film to which this invention carried out the laminating of the 1st layer membrane of lambdao / 4, and the 2nd layer membrane of lambda0 / 4 one by one from the glass-substrate side, the 2nd aforementioned layer membrane is a cascade screen which consists of the combination of a high refractive-index layer and a low refractive-index layer, and it is the multilayer antireflection film which has the conductivity characterized by an outside layer being a layer which has conductivity most from a glass-substrate side.
[0008] Although various technique, such as a vacuum deposition method, a spatter, a spray method, and a sol gel process of the liquid phase, is possible for the method of producing the multilayer antireflection film of this invention, its installation cost is cheap and it is desirable. [of the high ordinary-pressure CVD of a productivity]
[0009] Although a conductive material or a non-conducting material is sufficient as the 1st layer membrane in this invention, it is desirable that it is a property near insulation. That is, although conductivity is required of the outermost layer when used for an electro-optics element, an optoelectric transducer, or the window layer members of a touch panel, it is important that it is made not to affect the conductivity of this outermost layer.
[0010] Moreover, as a layer which has the conductivity used for the 2nd layer membrane in this invention, the tin

oxide, ITO, or a zinc oxide is mentioned.
[0011] Optical and the configuration which the tin oxide with comparatively conductivity and the 2nd layer membrane carry out the laminating of the silicon oxide and the high refractive index and conductive tin oxide of a low refractive index [side / 1st layer membrane] to the 1st layer membrane one by one from the viewpoint of being easy to control an electrical property are / that it is easy to produce a film by the method of producing a film under an ordinary pressure / desirable.
[0012] To design wavelength lambdao and refractive-index n, each thickness d of the 1st layer membrane in this invention and the 2nd layer membrane is given so that lambdao/4=nd may be satisfied. Design wavelength lambdao When a domain is set to 300-800nm, the thickness of 5-140nm and the conductive tin oxide has [the thickness of silicon oxide / in 40-100nm and the 2nd layer membrane in the thickness of the 1st layer membrane] desirable 5-100nm. In order to reduce the reflection factor of a visible ray effectively especially, it is design wavelength lambdao. It is desirable to make it about 550nm, therefore it is desirable that the thickness of silicon oxide [in 50-80nm and the 2nd layer membrane in the thickness of the 1st layer membrane] is 30-80nm, and the conductive tin oxide is 20-60nm.
[0013] Although especially the sheet resistance of the multilayer antireflection film of this invention is not limited, as intended use for an electro-optics element, an optoelectric transducer, or the window layer members of a touch panel, it is desirable that they are 300-5000ohm/**, and it is desirable that the sheet resistance of the conductive tin oxide the 2nd layer membrane in the sheet resistance of the 1st layer membrane] is 300-5000ohm/** more than 1000ohms / ** especially as an object for touch panels.
[0014] Although especially the configuration of a touch panel is not limited in applying the conductive multilayer antireflection film by this invention to a touch panel, the substrate top which covered the concerned conductive antireflection film on glass by contacting with a conductive pen etc. The touch panel of the type which measures the resistance from an electric conduction layer edge to a point of contact about lengthwise and longitudinal direction, and detects the position coordinate of a point of contact, Or make the electrode which becomes glass from the plastics film with an electric conduction layer through a spacer on the substrate which covered the concerned conductive antireflection film counter, and it arranges. The electric conduction layer which counters by pushing with a pen etc. from a film side can be contacted, and the touch panel of the type which detects the coordinate of the position which pushed from the electric conduction layer edge about lengthwise and longitudinal direction, and measured and pushed the resistance between positions etc. can be used.
[0015]
[Function] The laminating of the 1st layer membrane of lambdao / 4 and the 2nd layer membrane of lambda0 / 4 is carried out one by one from a glass-substrate side, this 2nd layer membrane is a cascade screen which consists of the combination of a high refractive-index layer and a low refractive-index layer, and the multilayer antireflection film of this invention in which an outside layer has conductivity most from a glass-substrate side has conductivity, permeability is high, and it is useful on the electric display device, the optoelectric transducer, or touch panel with which the enhancement in visibility is demanded.
[0016]
[Example]
The tin-oxide layer (a refractive index is 2.0) was formed as the 1st layer membrane of 62nm of thicknesss, having heated [example 1] soda-lime glass at 500 degrees C, and having used a tin tetrachloride, water, and the methanol as the raw material using the atmospheric pressure CVD system which has the film production section in three places. Next, the laminating of the tin-oxide layer (a refractive index is 2.0) which uses a mono silane and oxygen as a raw material, uses a tin tetrachloride, water, a methanol, and fluoric acid as a raw material for a 46nm silicon oxide layer (a refractive index is 1.45), and contains a 27nm fluorine as the 2nd layer membrane was carried out one by one on the 1st layer membrane.
[0017] When permeability was measured about this sample, in the wavelength of 550nm, it was 94%, and the transparency which stood high was shown and the reflection factor was 5%. Moreover, the sheet resistance of a multilayer antireflection film was 1000ohm/**.
[0018] [Example 2] soda-lime glass was heated at 500 degrees C, and the tin-oxide layer (a refractive index is 2.0) which uses a tin tetrachloride, water, a methanol, and fluoric acid as a raw material, and contains a fluorine as the 1st layer membrane of 62nm of thicknesss was formed using the atmospheric pressure CVD system which has the film production section in three places. Next, as the 2nd layer membrane, the laminating of the 27nm tin-oxide layer (a refractive index is 2.0) was carried out one by one on the 1st layer membrane, having used a tin tetrachloride, water, a

methanol, and fluoric acid as the raw material for the 46nm silicon oxide layer (a refractive index is 1.45) having used a mono silane and oxygen as the raw material.

[0019] When permeability was measured about this sample, in the wavelength of 550nm, it was 95%, and the transparency which stood high was shown and the reflection factor was 5%. Moreover, the sheet resistance of a multilayer antireflection film was 1000ohm/**.

[0020] The laminating of the 27nm tin-oxide layer was carried out one by one, having used [heated [example 1 of comparison] soda-lime glass at 500 degrees C and] a 40nm silicon oxide layer and a tin tetrachloride, water, a methanol, and fluoric acid as the raw material having used a mono silane and oxygen as the raw material using the atmospheric pressure CVD system which has the film production section in two places.

[0021] When permeability was measured about this sample, in the wavelength of 550nm, it was 89%, and the reflection factor was 11%. Moreover, the sheet resistance of a multilayer antireflection film was 1000ohm/**.

[0022] The 27nm tin-oxide layer was produced, having heated [example 2 of comparison] soda-lime glass at 500 degrees C, and having used a tin tetrachloride and water as the raw material using the atmospheric pressure CVD system which has the film production section in one place.

[0023] When permeability was measured about this sample, in the wavelength of 550nm, it was 86%, and the reflection factor was 10%. Moreover, the sheet resistance of a multilayer antireflection film was 2000ohm/**.

[0024]

[Effect of the Invention] The multilayer antireflection film of this invention has high permeability, and is useful on the optoelectric transducer or touch panels with which the enhancement in electric display devices, such as a liquid-crystal-display element as which a film can be produced by the high ordinary-pressure CVD of a productivity, and the enhancement in visibility is required, and a plasma display, and a conversion efficiency is demanded, such as a solar battery.

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(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平6－316442

(43)公開日　平成６年(1994)11月15日

(51)Int.Cl.⁵	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｃ０３Ｃ　17/34		Ｚ　7003－4Ｇ		
17/245		Ｚ　7003－4Ｇ		

審査請求　未請求　請求項の数11　ＯＬ　（全 3 頁）

(21)出願番号　特願平6－39969

(22)出願日　平成６年(1994)３月10日

(31)優先権主張番号　特願平5－78903

(32)優先日　平５(1993)３月12日

(33)優先権主張国　日本（ＪＰ）

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(54)【発明の名称】　導電性を有する多層反射防止膜

(57)【要約】

【構成】ガラス基板側からλ₀／４の第１層膜、λ₀／４の第２層膜を順次積層した多層反射防止膜において、前記第２層膜は高屈折率膜と低屈折率膜の組合わせからなる積層膜であり、かつ、ガラス基板側から最も外側の膜は導電性を有する膜である導電性を有する多層反射防止膜。

【効果】透過率が高く、生産性の高い常圧ＣＶＤ法で製膜可能であり、タッチパネルなどに有用である。

【特許請求の範囲】

【請求項1】ガラス基板側からλ0／4の第1層膜、λ0／4の第2層膜を順次積層した多層反射防止膜において、前記第2層膜は高屈折率膜と低屈折率膜の組合わせからなる積層膜であり、かつ、ガラス基板側から最も外側の膜は導電性を有する膜であることを特徴とする導電性を有する多層反射防止膜。

【請求項2】第1層膜および第2層膜が常圧CVD法を用いて製造されてなる請求項1の多層反射防止膜。

【請求項3】第1層膜が酸化スズであり、第2層膜が第1層膜側から酸化ケイ素および導電性の酸化スズを順次積層したものである請求項1または2の多層反射防止膜。

【請求項4】第1層膜の酸化スズおよび／または第2層膜中の酸化スズは、水、メタノールおよびフッ酸から選ばれる少なくとも1種と、塩化スズとを原料として形成されるものである請求項3の多層反射防止膜。

【請求項5】第1層膜の酸化スズの膜厚が40～100nmであり、第2層膜の酸化ケイ素の膜厚が5～140nmおよび酸化スズの膜厚が5～100nmである請求項3または4の多層反射防止膜。

【請求項6】第1層膜の酸化スズの膜厚が50～80nmであり、第2層膜の酸化ケイ素の膜厚が30～80nmおよび酸化スズの膜厚が20～60nmである請求項5の多層反射防止膜。

【請求項7】多層反射防止膜のシート抵抗値が300～50000Ω／□である請求項1～6のいずれか1項の多層反射防止膜。

【請求項8】第1層膜の酸化スズ膜のシート抵抗値が1000Ω／□以上である請求項3～7のいずれか1項の多層反射防止膜。

【請求項9】第2層膜を構成する酸化スズ膜のシート抵抗値が300～50000Ω／□である請求項3～8のいずれか1項の多層反射防止膜。

【請求項10】電気光学素子または光電変換素子の窓層部材の少なくとも一部に用いられる請求項1～9のいずれか1項の多層反射防止膜。

【請求項11】導電膜付きプラスチックフィルム、スペーサ、および導電膜付きガラスの一部または全部から構成されるタッチパネルにおいて、前記導電膜付きガラスに請求項1～9のいずれか1項の多層反射防止膜が用いられることを特徴とするタッチパネル。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明はタッチパネルや太陽電池等の電気部品の窓層部材として用いられる導電性を有する多層反射防止膜に関する。

【0002】

【従来の技術】従来、ガラスなどの透明光学部材を液晶表示素子、プラズマ表示パネルなどの電気光学素子、太陽電池等の光電変換素子またはタッチパネルなどに直接あるいは間接的に窓層部材として用いる場合には、視認性や変換効率を向上させることが重要であった。このため、これら光学部材表面での反射損失を低減して透過率を向上させる方法として、表面に反射防止膜を設けて部材背面側への透過光量を高めることが知られている。

【0003】反射防止膜の膜構成は従来から光干渉を利用した単層または2層以上の多層膜からなり、TiO_2、ZrO_2、SiO_2、Al_2O_3などの電気絶縁性材料が用いられており、導電性を付与した多層反射防止膜に関する例は少ない。

【0004】一方、導電性を与えるための透明かつ高屈折率で導電性を有する薄膜材料としてはITO、酸化スズ、酸化亜鉛が知られている。ITO、酸化亜鉛は主として真空蒸着法あるいはスパッタ法などの真空を用いた方法で製膜される。一方、酸化スズについては、真空法は光学的／電気的特性の制御性が悪いため、一般的には粉末あるいは液体原料を用いたスプレー法あるいは原料を気化させるCVD法など大気圧下の熱分解反応を用いることが知られている。

【0005】すなわち、前述のように膜材料によって最適な製膜法が異なり、膜材料によって数種類の製膜装置を備えることは設備費および生産性に大きく影響し、コスト面で大きな障害となる。

【0006】

【発明が解決しようとする課題】本発明は、低コストで効率よく製造される生産性の高い電気光学素子用、光電変換素子用あるいはタッチパネル用の新規な透明導電性多層反射防止膜の提供を目的とする。

【0007】

【課題を解決するための手段】本発明は、ガラス基板側からλ0／4の第1層膜、λ0／4の第2層膜を順次積層した多層反射防止膜において、前記第2層膜は高屈折率膜と低屈折率膜の組合わせからなる積層膜であり、かつ、ガラス基板側から最も外側の膜は導電性を有する膜であることを特徴とする導電性を有する多層反射防止膜である。

【0008】本発明の多層反射防止膜の製膜法は、真空蒸着法、スパッタ法、スプレー法、液相のゾルゲル法などいろいろな方法が可能であるが、設備費が安価で生産性の高い常圧CVD法が好ましい。

【0009】本発明における第1層膜は、導電性材料でも非導電性材料でもよいが、絶縁性に近い特性であることが望ましい。すなわち、電気光学素子、光電変換素子またはタッチパネルの窓層部材用に用いられる場合には、最外層に導電性が要求されるが、この最外層の導電性に影響を及ぼさないようにすることが重要である。

【0010】また、本発明において第2層膜に用いる導電性を有する膜としては、酸化スズ、ITOまたは酸化亜鉛などが挙げられる。

【００１１】常圧下での製膜法で製膜しやすく光学的および電気的特性を制御しやすいという観点から、第１層膜に比較的導電性の低い酸化スズ、第２層膜は第１層膜側から、低屈折率の酸化ケイ素および高屈折率かつ導電性の酸化スズを順次積層する構成が好ましい。

【００１２】本発明における第１層膜および第２層膜のそれぞれの膜厚ｄは、設計波長λ。および屈折率ｎに対して、λ。／４＝ｎｄを満足するように与えられる。設計波長λ。の範囲を３００～８００ｎｍとすると、第１層膜の膜厚は４０～１００ｎｍ、また第２層膜における酸化ケイ素の膜厚は５～１４０ｎｍ、導電性酸化スズの膜厚は５～１００ｎｍが好ましい。特に、可視光線の反射率を効果的に低減するには、設計波長λ。をおよそ５５０ｎｍにすることが好ましく、したがって、第１層膜の膜厚が５０～８０ｎｍ、また第２層膜における酸化ケイ素の膜厚が３０～８０ｎｍ、導電性酸化スズが２０～６０ｎｍであることが好ましい。

【００１３】本発明の多層反射防止膜のシート抵抗値は特に限定されないが、電気光学素子、光電変換素子またはタッチパネルの窓層部材用の用途としては、３００～５０００Ω／□であることが好ましく、特に、タッチパネル用としては第１層膜のシート抵抗値が１０００Ω／□以上、第２層膜における導電性酸化スズのシート抵抗値が３００～５０００Ω／□であることが好ましい。

【００１４】本発明による導電性多層反射防止膜をタッチパネルに応用するうえでタッチパネルの構成は特に限定されないが、ガラスに当該導電性反射防止膜を被覆した基板上を導電性のペン等で接触することにより、縦方向および横方向について導電膜端部から接触点までの抵抗を測定して接触点の位置座標を検知するタイプのタッチパネル、または、ガラスに当該導電性反射防止膜を被覆した基板上にスペーサを介して導電膜付きプラスチックフィルムからなる電極を対向させて配置し、フィルム側からペン等で押すことにより対向する導電膜を接触させ、縦方向および横方向について導電膜端部から押し位置間の抵抗を測定して押した位置の座標を検知するタイプのタッチパネルなどを用いることができる。

【００１５】

【作用】ガラス基板側からλ。／４の第１層膜、λ。／４の第２層膜を順次積層し、この第２層膜は高屈折率膜と低屈折率膜の組合わせからなる積層膜であり、かつ、ガラス基板側から最も外側の膜は導電性を有する本発明の多層反射防止膜は、導電性を有し、透過率が高く、視認性の向上が要求される電気表示素子、光電変換素子またはタッチパネルに有用である。

【００１６】

【実施例】

〔実施例１〕ソーダライムガラスを５００℃に加熱し、３ケ所に製膜部を有する常圧ＣＶＤ装置を用いて、四塩化スズ、水およびメタノールを原料として膜厚６２ｎｍの第１層膜として酸化スズ膜（屈折率は２．０）を形成した。次に第２層膜として、モノシランおよび酸素を原料として４６ｎｍの酸化ケイ素膜（屈折率は１．４５）を、四塩化スズ、水、メタノールおよびフッ酸を原料として２７ｎｍのフッ素を含有する酸化スズ膜（屈折率は２．０）を第１層膜の上に順次積層した。

【００１７】この試料について透過率を測定したところ、波長５５０ｎｍにおいて９４％であり、卓越した透明性を示し、また反射率は５％であった。また、多層反射防止膜のシート抵抗値は１０００Ω／□であった。

【００１８】〔実施例２〕ソーダライムガラスを５００℃に加熱し、３ケ所に製膜部を有する常圧ＣＶＤ装置を用いて、四塩化スズ、水、メタノールおよびフッ酸を原料として膜厚６２ｎｍの第１層膜としてフッ素を含有する酸化スズ膜（屈折率は２．０）を形成した。次に第２層膜として、モノシランおよび酸素を原料として４６ｎｍの酸化ケイ素膜（屈折率は１．４５）を、四塩化スズ、水、メタノールおよびフッ酸を原料として２７ｎｍの酸化スズ膜（屈折率は２．０）を第１層膜の上に順次積層した。

【００１９】この試料について透過率を測定したところ、波長５５０ｎｍにおいて９５％であり、卓越した透明性を示し、また反射率は５％であった。また、多層反射防止膜のシート抵抗値は１０００Ω／□であった。

【００２０】〔比較例１〕ソーダライムガラスを５００℃に加熱し、２ケ所に製膜部を有する常圧ＣＶＤ装置を用いて、モノシランおよび酸素を原料として４０ｎｍの酸化ケイ素膜および四塩化スズ、水、メタノールおよびフッ酸を原料として２７ｎｍの酸化スズ膜を順次積層した。

【００２１】この試料について透過率を測定したところ、波長５５０ｎｍにおいて８９％であり、また反射率は１１％であった。また、多層反射防止膜のシート抵抗値は１０００Ω／□であった。

【００２２】〔比較例２〕ソーダライムガラスを５００℃に加熱し、１ケ所に製膜部を有する常圧ＣＶＤ装置を用いて、四塩化スズおよび水を原料として２７ｎｍの酸化スズ膜を製膜した。

【００２３】この試料について透過率を測定したところ、波長５５０ｎｍにおいて８６％であり、また反射率は１０％であった。また、多層反射防止膜のシート抵抗値は２０００Ω／□であった。

【００２４】

【発明の効果】本発明の多層反射防止膜は透過率が高く、生産性の高い常圧ＣＶＤ法で製膜可能であり、視認性の向上が要求される液晶表示素子、プラズマ表示などの電気表示素子、変換効率の向上が要求される太陽電池などの光電変換素子またはタッチパネルに有用である。